

DESIGN GUIDELINES

USAREUR - Restoration Program of Troop Billets - Standard 1+1

		SOURCE
B 11	HEATING SYSTEM	B 01
B 11.1	Standards and Guidelines	
The design shall be based upon German standards and guidelines. If U.S. Forces standards contain more stringent requirements, the U.S. standards shall be applied.		B 02
B 11.2	Marking	
All equipment and piping shall be identified with laminated presswood signs with permanently engraved lettering in German and English.		B 03
Function schematics of built-in system, permanently protected, CAD-quality (computer-aided-design) shall be posted in central mechanical plants.		B 04
All pipelines and built-in parts in mechanical central station shall be lettered permanently in German and English.		B 05
B 11.3	Heat Generation	
It must be decided in cooperation with the applicable DPW in each individual case, which type of heat generation offers the energetically most sensible solution.		B 06
The heat exchanger capacity shall be dimensioned at least to the connection value of building heating. If the capacity requirement for the drinking water heater is higher than value listed above, this value shall be taken as basis.		B 07
The water heaters shall be connected control technically with the building heating and equipped with a priority switching for the water heaters.		B 08
Attention shall be pointed out at control technical systems for the drinking water heating that the control hysteresis not exceeds the temperature limits of DVGW Work Sheets.		B 09
Heat quantity meters shall be installed.		
B 11.3.1	Calculation Heat Requirement	B 10
Heat requirement shall be calculated acc. to DIN 4701 and/or DIN pr EN 12831.		
Submission of thermal protection proof.		B 11
		B 12
		B 13
		B 14
		B 15

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Fig 11.3.1 Room temperatures

Room sections	°Celsius	Fahrenheit
Storage bin rooms attic	10	34
bathrooms / bedrooms	24	75
Offices and/or storage rooms	20	68
Corridors	18	65
Bedrooms	20	68
Kitchens	20	68
Janitor's closets	18	65
Mud rooms	18	65
Mechanical rooms	> 5	> 17
Latrines women / men basement	24	75
Latrines women / men attic	20	68
Stairwells	18	65
Game room	20	68
Arms room	20	68
Laundry	20	68

B 11.4 Section of Pipe Materials

Only incombustible construction materials acc. to construction material class A1 acc. to DIN 4102 shall be used in the corridor of basement and in escape routes.

Threaded pipes will be used.

Seamless steel pipes (steam pipes) will be used as of DN 50

Pipes acc. to DIN 2441 shall only be used in special cases.

Pipes made of unalloyed steel acc. to DIN 2384 with factory coating of PP in creme white RAL 9010 shall be provided for surface mounted pipes.
Rod material shall be used, soft steel pipes in rings are not allowed.

B 11.5 Selection of Radiators

Panel radiators shall be provided.

Dimensioning of radiators shall be accomplished acc. to VDI 6030.
Level 1 "Coverage of heating load without removal of comfort deficits will be selected as requirement level acc. to VDI 6030.

Heat capacity tested acc. to DIN EN 442 – ½.

Baked-on powder finish paint acc. to DIN 55900.

SOURCE

B 01

B 02

B 03

B 04

B 05

B 06

B 07

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B 09

DIN 4102

B 10

DIN 2440
DIN 2448

B 11

DIN 2441

DIN 2394

B 12

B 13

VDI 6030

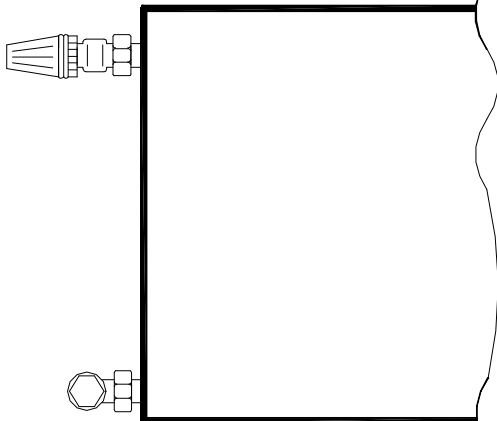
B 14

DIN EN 442

B 15

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SOURCE		
DIN EN 215	Material thickness: Sheet thickness of water leading front panel min. 2 mm, profiled back side min. 1.25 mm sheet thickness.	B 01
	Convection sheets are not acceptable.	B 02
	Possible radiator types are: Make Type Gerhard & Rauh Essen Baufau Monplan Hagan Formaplan. Zehnder Plano Hudevad P 5	B 03
	The radiators shall be installed in the parapet niches as far as possible.	B 04
	B 11.6 Selection of thermostat valves and thermostat heads Thermostat valves as per DIN EN 215. Thermostat heads in accordance with the requirements of Federal Agency for Military Engineering.	B 05
	The thermostat valves at the radiators shall be installed as per Fig. 11.2.	B 06
	Fig 11.6 Arrangement thermostat valve	B 07
		B 08
		B 09
		B 10
	Axial valves shall be used in order to avoid danger of injury. If this arrangement is not possible, angle-corner valves (thermostat head is standing vertical) shall be used.	B 11
	The radiators shall be equipped with shut-off check unions as well as ventilation valves.	B 12
	Central ventilation of radiators is not acceptable.	B 13
	B 11.7 Heating control The type of heating control shall be coordinated with the applicable U.S. Community.	B 14
	Connection to the energy monitoring control system (EMCS) with possibility for remote control of system and inquiry of operation parameters shall be provided if possible.	B 15

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SOURCE

Type of control and/or control make shall be coordinated with the user of system prior to commencement of design.

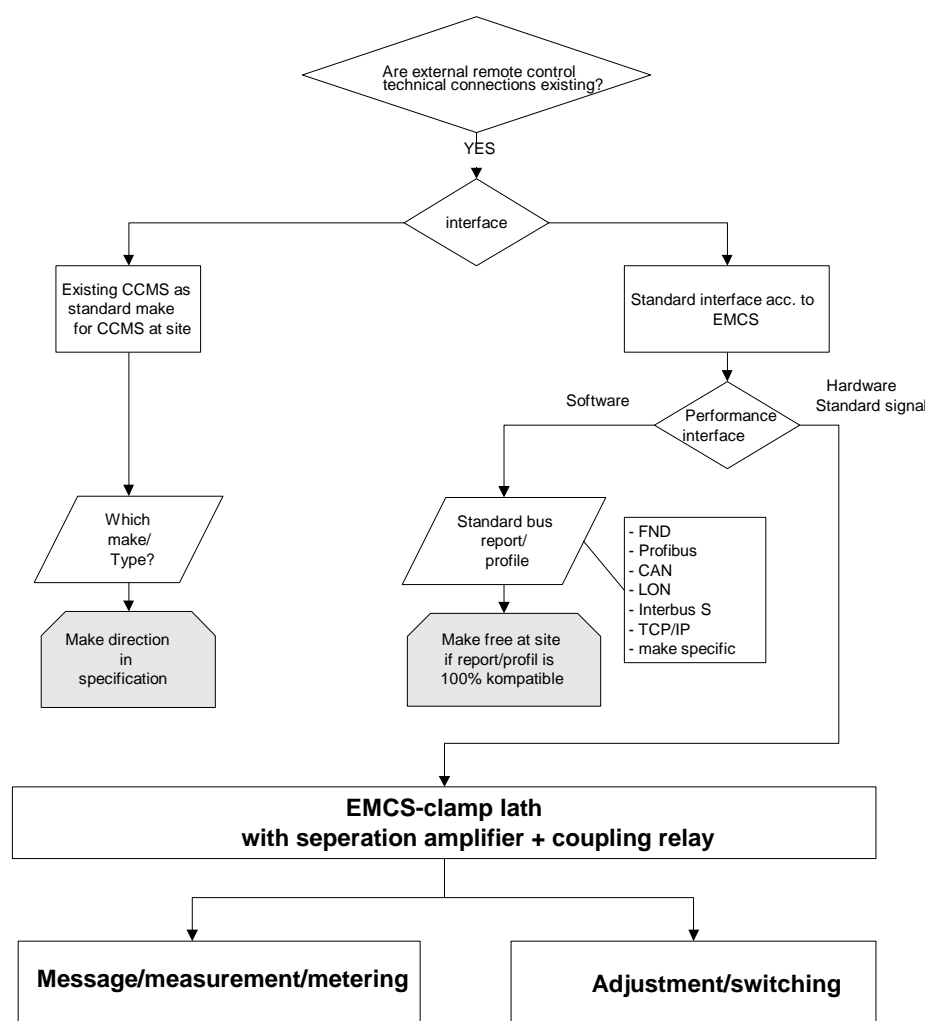
Individual parameters to be connected to CCMS-system (GLT = Central Control and Monitoring System) shall be coordinated with the user of system.

A course plan for determination of control technical systems in barracks acc. to Standard 1 + 1 is represented in **Fig. 11.3, Fig. 11.4 and Fig. 11.5.**

This course plans shall support the designer at determination of required control technical components.

Basically, it must be assumed that a self-sufficient DDC-station will be erected at the site.

Fig 11.7.1 Principle definition of DDC – systems



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Fig 11.7.2 Operational planning exit side

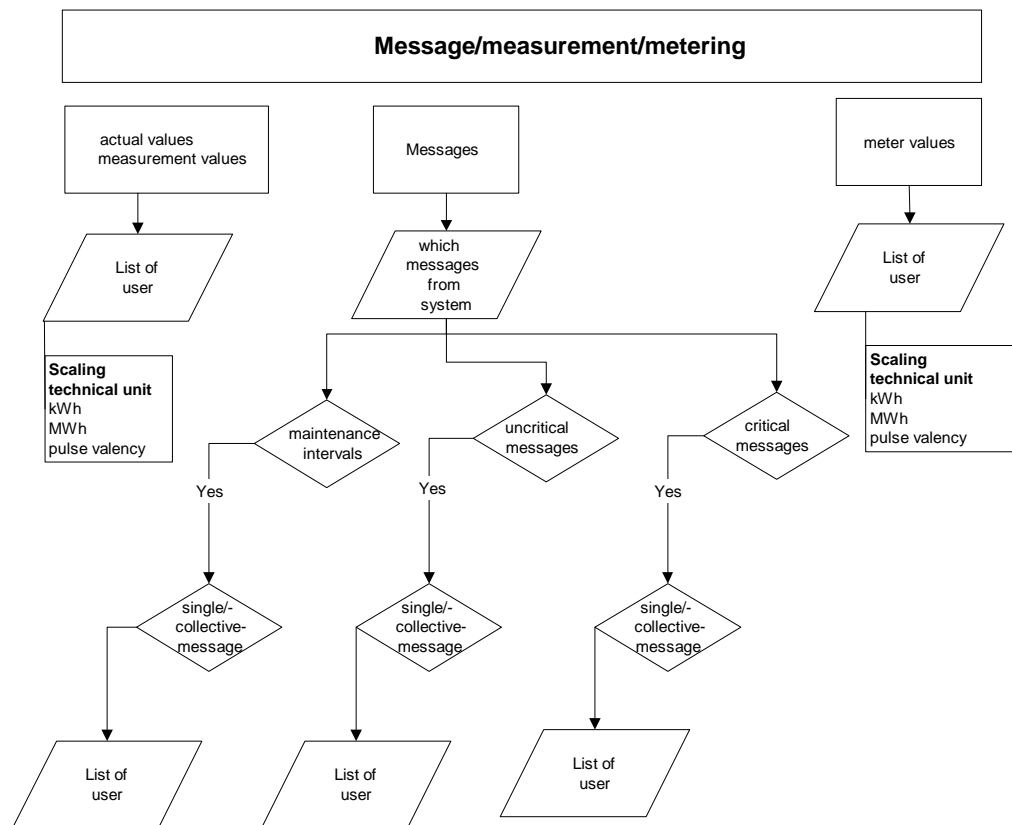
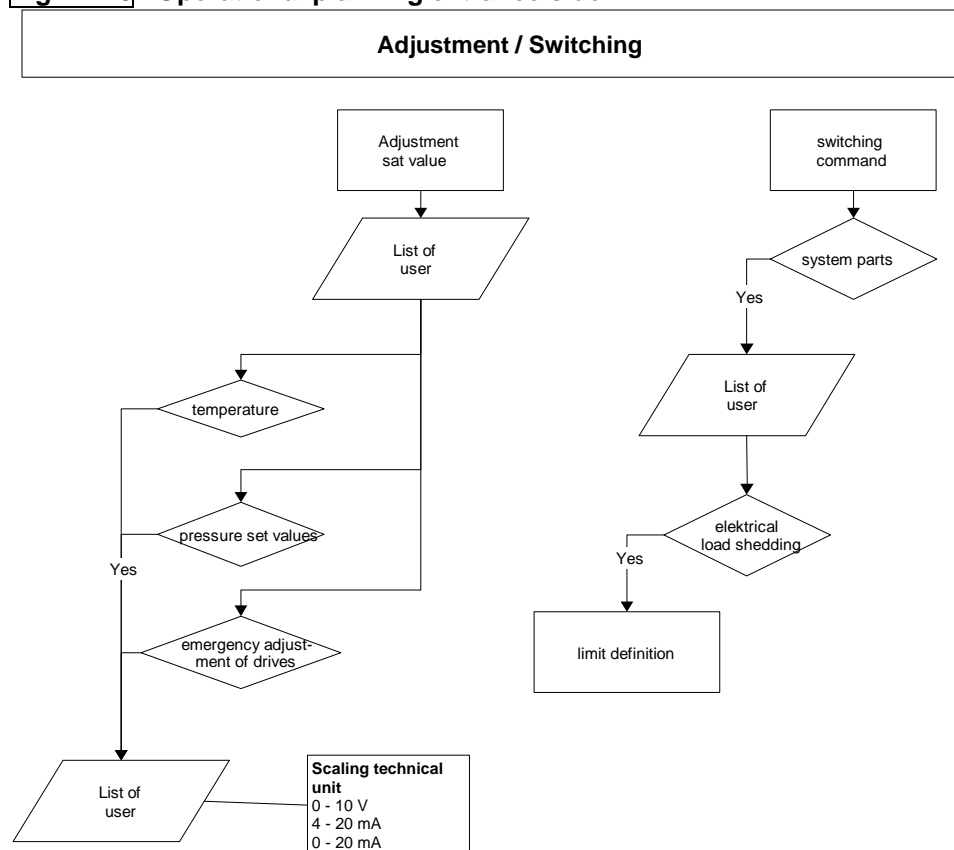


Fig 11.7.3 Operational planning entrance side



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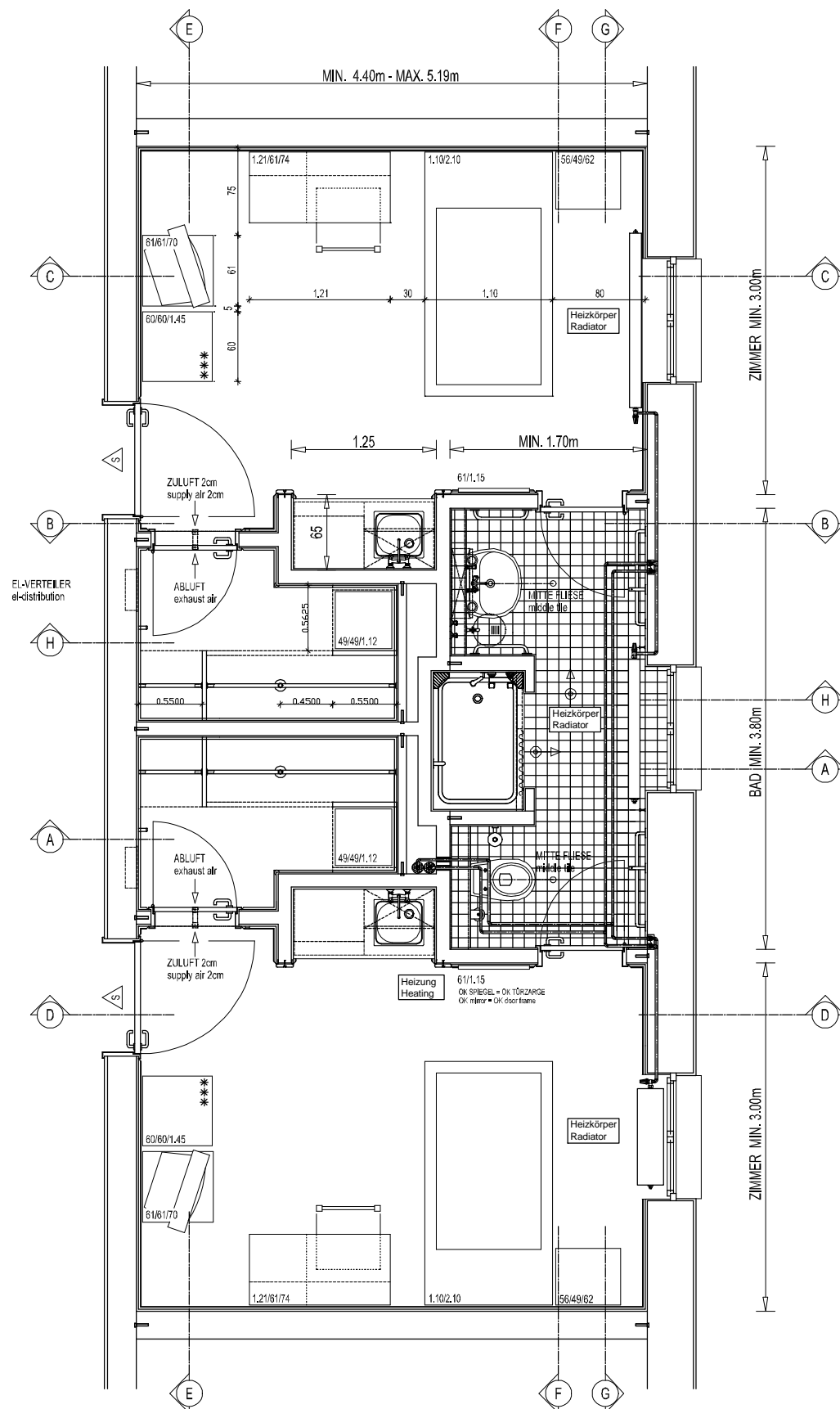
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SOURCE		
B 11.8 Balancing of the Heating System The heating system shall be balanced acc. to DIN 18 380 Riser control valves with pre-adjustment shall be used. Riser control valves with differential pressure control shall be used at widely ramified systems.	DIN 18 380	B 01
		B 02
		B 03
		B 04
		B 05
		B 06
B 11.9 Pipe Routing Heating lines in basement are running along both longitudinal sides of building and connect to risers. Distribution lines shall be properly routed underneath the ceiling (not in bedrooms). It is important to use a uniform fastening method for all mechanical building elements. Risers shall be installed in shafts or flush mounted. If this is not possible, they shall be surface mounted. The maximum distance between finished wall surface and rear edge of pipe and/or insulation is 3 cm. Radiators in corridors shall be supplied with own risers. These lines shall be installed possibly flush mounted. If this is not possible due to statical reasons, they shall be surface mounted. The above listed conditions concerning pipe material and distance to wall will apply. Horizontal connection lines shall be as short as possible. Separate risers shall be provided for radiators installed in corners. In case of wall/ceiling passages, piping shall be separated from the structure with reference to sound transmissions. Special form pieces allowing installation of radiator connection lines without crossing are not acceptable. Generally applicable: proper and solid pipe routing is of great importance. An adequate number of fastening devices shall be provided. No lines shall be led through the arms room. Short connection line for supply of radiator in arms room is acceptable. Lines through stairwells If possible, no lines shall be led through the stairwells. If it is absolutely necessary, appropriate fire protection measurements have to be done. Pipe routing bathroom / bedrooms A possible pipe routing within the bathrooms / bedrooms is shown in Fig. 11.9-1 up to Fig. 11.9-6.	DIN 4109	B 07
		B 08
		B 09
		B 10
		B 11
		B 12
		B 13
		B 14
		B 15

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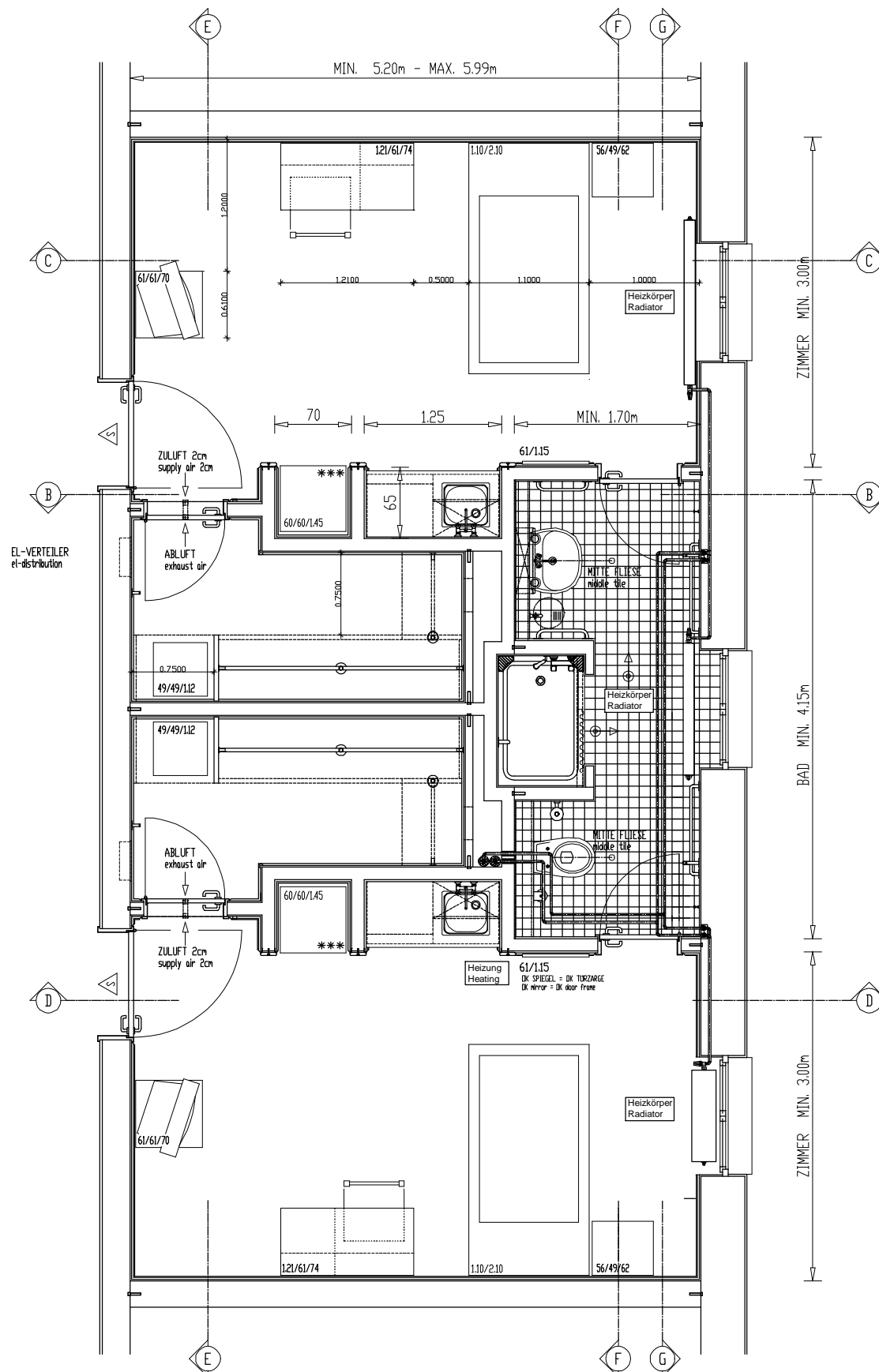
Fig 11.9 -1 Example layout Type 1



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Fig 11.9 – 2 Example layout Type 2



B 01

B 02

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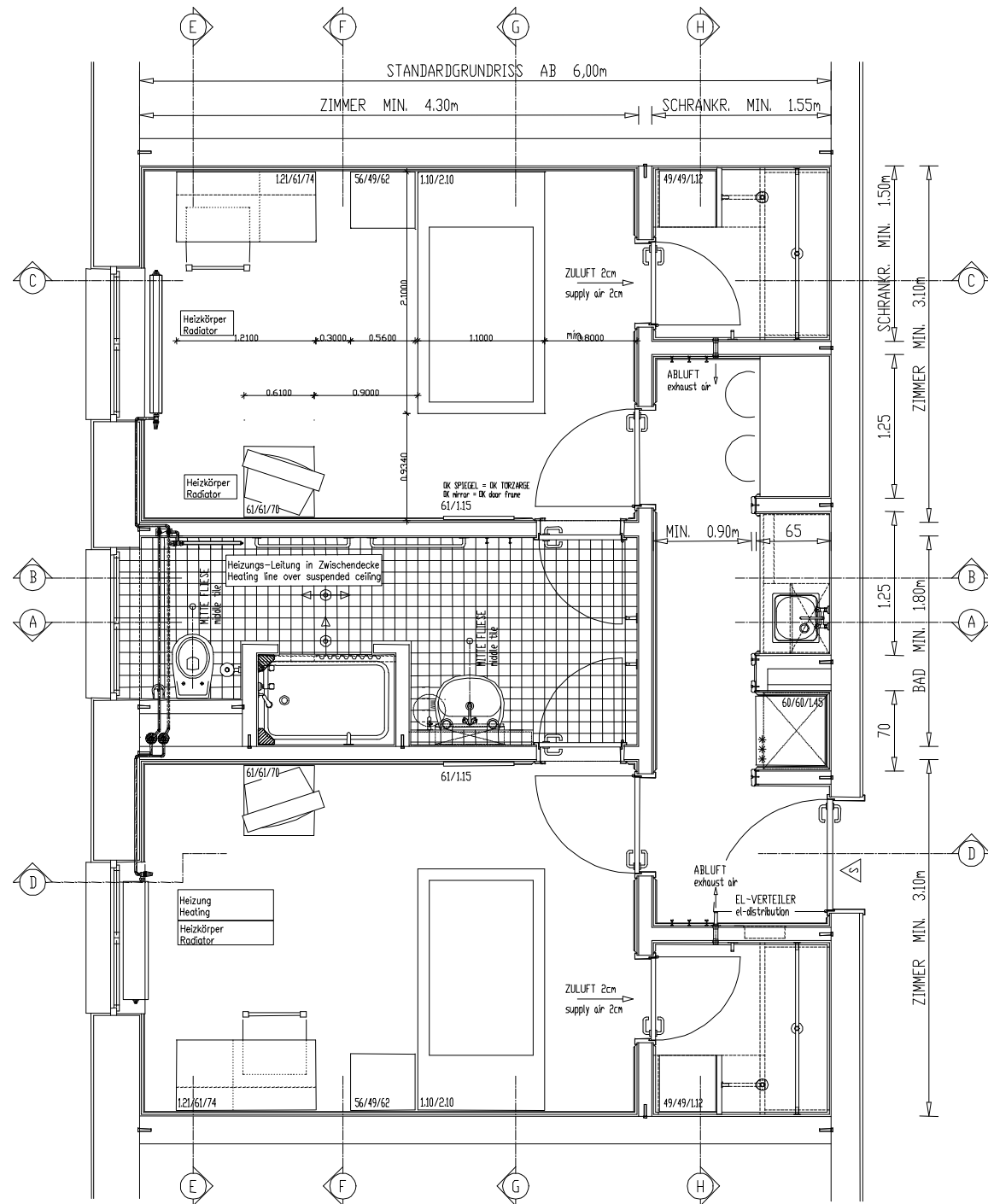
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Fig 11.9 – 3 Example layout Type 3



B 01

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B 03

B 04

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MIN. 4.40m

121/61/74

110/210

56/49/62

61/61/70

60/60/145

1.2100

0.3000

1.1000

0.8000

0.7500

0.6500

0.6000

1.25

MIN. 1.70

ZULUFT 2cm
supply air 2cm

ABLUFT
exhaust air

61/115

49/49/112

MITTE-FLIESE
middle tile

95

Heizkörper
Radiator

EL-VERTEILER
e-distribution

A

ABLUFT
exhaust air

ZULUFT 2cm
supply air 2cm

61/115

49/49/112

MITTE-FLIESE
middle tile

Heizkörper
Radiator

Heizkörper
Radiator

Heizkörper
Radiator

121/61/74

110/210

56/49/62

61/61/70

60/60/145

MIN. 3.00m

MIN. 3.80m

MIN. 3.00m

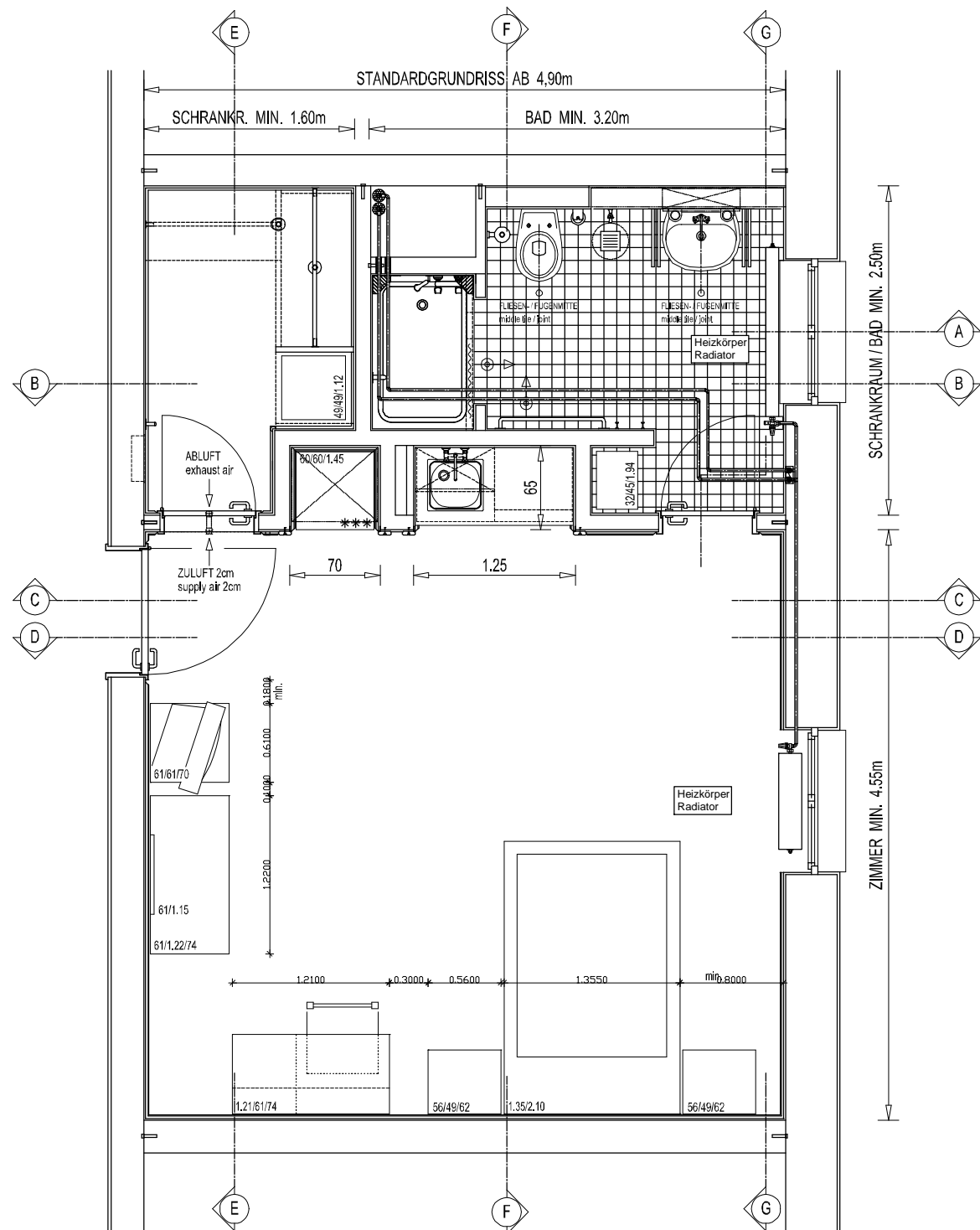
A

B 15

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Fig 11.9 – 5 Example layout Type 5



B 01

B 02

B 03

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B 13

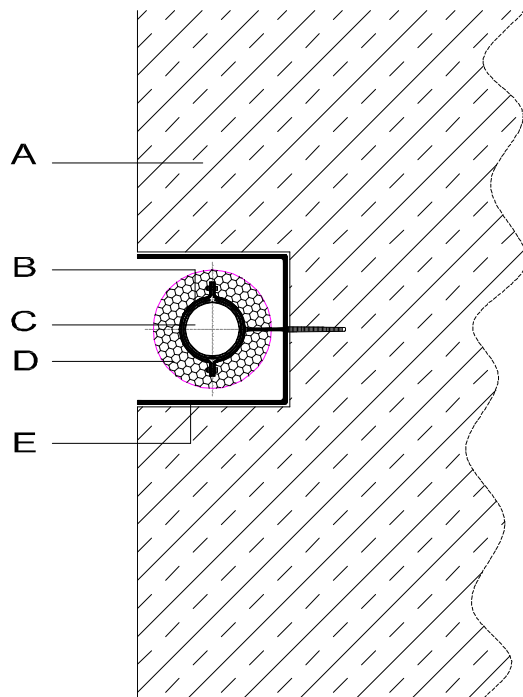
B 14

B 15

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Fig 11.9 – 6 Radiator-connection in horizontal wall slit



This means:

- A** Wall
- B** Pipe clamp with profile rubber acc. to DIN 3567
- C** Steel pipe acc. to DIN 2440 Ø 21.3 mm
- D** Insulation layer thickness 13 mm
- E** U-profile acc. to statical requirements

Identification signs

All shut-offs shall be identified as described above. The identification shall be fastened either via tension lock at pipe or fitting, or a sheet metal sign shall be fastened to the fitting via small link chain.

Stick-on of identification to insulation is not allowed.

The identification of shut-offs shall allow a reference to the inspection documents.

B 11.10 Thermal insulation

All pipelines shall be insulated in accordance with the Heating System Ordinance.

Thermal insulation in escape routes shall consist of materials acc. to construction material class A acc. to DIN 4102.

Piping in escape routes shall be covered with an additional jacket made of galvanized sheet steel (sheet thickness 0.5 mm).

Piping in central mechanical plants shall be covered with an additional jacket of galvanized sheet steel (sheet thickness 0.5 mm).

Distribution lines in exposed areas outside of escape routes shall be covered with an additional jacket of PVC.

SOURCE

DIN 3567
DIN 2440

HeizAnIV

DIN 4102

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B 11

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Appropriate easily dismantable insulation caps shall be used for fixtures. Insulation materials shall meet the requirements of construction material class A1, A2, B1.

Heating lines shall be insulated in such a way that a heat transmission between feed line and return line is prevented.

Fig 11.10 Requirements on the accomplishment of the thermal insulation:

Storage bin rooms attic	acc. to heating system regulations with add. coat made of PVC
Bathrooms / bedrooms	not insulated
Offices and/or storage room	not insulated
Corridors basement	acc. to heating system regulations with add. sheet coat
Game room	not insulated
Bedrooms	not insulated
Janitor's closet	acc. to heating system regulations with add. coat made of PVC
Mud room	acc. to heating system regulations with add. coat made of PVC
Latrines women / men basement	not insulated
Latrines women / men attic	no insulated
Mechanical rooms	acc. to heating system regulations with add. sheet coat
Laundry	acc. to heating system regulations with add. coat made of PVC

B 11.11 Sound Insulation Requirements

Applicable are the guidelines of DIN 4109.

Sound insulation inlays shall be used for pipe fastening devices. Decoupling of pipes from the structure is important.

B 11.12 Fire Protection Requirements

Guidelines of DIN 4102 will apply.

The dependence between proper accomplishment of ceiling/wall passage acc. to sound insulation guidelines under consideration of fire protection at the same time shall be strictly observed.

Especially, this means:

1. Openings and/or chases shall be kept as small as possible
2. Remaining openings shall be closed with incombustible construction materials.
3. Required coverings (sound insulation) in the area of openings shall be accomplished with mineral fibers showing a melting temperature of min. 1000°C.
4. The flush mounted installation of remaining rest wall thickness at staircases and fire sections shall reconstruct the fire resistance class of construction element.

SOURCE

DIN 4102

B 01

B 02

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DIN 4109

B 09

DIN 4102

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		SOURCE	
B 11.13	Warm water generation		B 01
B 11.13.1	Basis		
Basis for dimensioning of warm water generation in barracks is ETL 11103-489 in edition of April 3,1998.		ETL 489	B 02
This guideline was prepared by Department of the Army, this means, U.S. Army Corps of Engineers.			
This guideline is valid for all HQUSACE facilities and facilities with military character under USACE control.			B 03
It considers the special utilization of barracks (high simultaneousness at utilization of shower facilities) and delivers the required characteristic values.			B 04
The original guideline ETL 1110-3-489, an example calculation as well as a comparison with German standards and guidelines can be called under internet address www.tga-net.de/deutsch/knowhow/etl-489 .			B 05
B 11.13.2	Characteristic values and term determination		
Boiler temperature T_{SP} [°C]			B 06
The boiler temperature shall be dimensioned to min. 60° C in order to avoid legionnaire accumulation.			
$T_{SP} = 60^{\circ} \text{ C}$			B 07
Mixed water temperature T_{MW} [°C]			
The maximum warm water temperature shall be limited with a central mixed water station to max. 43°C.		B 10	
Further accomplishment for central mixed water station see chapter B 10.			B 08
$T_{MW} = 43^{\circ} \text{ C}$			
Utilization duration t_B [minutes]			B 09
The time used per person for body cleaning. It composes of 7.5 minutes showering and 2 minutes water consumption at wash basin.			
$t_B = 9.5 \text{ minutes}$			B 10
Water consumption per person during utilization duration V_{PiB} [l/P]			
The quantity of water used per user during utilization duration t_B . It is calculated from the maximum flow through a shower head of approx. 9.5l/minute and utilization duration t_B with 9.5 minutes.			B 11
$V_{PiB} = 90\text{L/P}$			B 12
Peak consumption V_{SP} [l]			
The warm water consumption arising during main utilization time. Calculation see item B 11.13.4.		B 11.13.4	B 13
Boiler size V_{TANK} [l]			
The selected boiler size. Calculation see item B 11.13.4.		B 11.13.4	B 14
			B 15

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		SOURCE	
<p>Permanent capacity R [l/hour] The quantity of warm water to be provided by the boiler in a defined time. Usually known under term of "10 minutes capacity". Calculation see item B 11.13.4.</p> <p>Heat loss via pipelines q [kW / m] Heat loss arising per meter pipeline.</p> <p>Utilization time d [hours] The entire shower time at the evening. It is calculated from the number of showers as well as the number of users per shower. Two users per shower bath are estimated in connection with the design of barracks.</p> <p>Spec. heat capacity water C_w [Wh / kg K] Spec. heat capacity of water.</p> <p>Number of shower bathrooms Du [each] Shower bathrooms installed in building. General showers installed in basement and/or attic are not included in calculation.</p> <p>Number of users P [persons] Number of persons at full occupation of building.</p> <p>B 11.13.3 Additional Notes Filters shall be installed in front of mixed water station.</p> <p>Water connection shall be provided acc. to DIN 1988.</p> <p>An expansion vessel with DVGW allowance shall be installed in the cold water supply line. The dimensioning shall be accomplished acc. to chapter 12 of ASHRAE System and Equipment Handbook.</p> <p>Boiler and heat exchanger shall be arranged in the same room if possible in order to avoid heat losses.</p> <p>Heat generation The heating of warm water boiler shall be made via central heat generation. If the central heat generation is not available in sufficient quantity during the entire year, operation and provision costs shall be calculated for following alternatives and decision in coordination with responsible authorities shall be made.</p> <p>Alternatives of warm water generation</p> <ul style="list-style-type: none"> a) Direct fired warm water heater b) Decentral heat generation for warm water heating 	B 11.13.4		B 01
			B 02
			B 03
			B 04
			B 05
			B 06
			B 07
			B 08
			B 09
			B 10
			B 11
			B 12
			B 13
			B 14
			B 15

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		SOURCE
B 11.13.3.1 Conversion factors		B 01
Following conversion factors shall be used.		
Energy units		B 02
1 kWh	=	3414 BTU
1 BTU	=	0.293 x 10 ⁻³ kW
Volume		B 03
1 liter	=	0.26428 gal
1 gal	=	3.785 l
Further factors are shown in the usual publications (e.g.: Recknagel Sprengel Hönnmann).		B 04
B 11.13.4 Calculation		B 05
B 11.13.4.1 Additional notes		B 06
The systems shall be dimensioned to a 100 % occupation.		
The systems shall be planned in such a manner that all users can use the showers at the same time.		
The stay time between both shower processes of appropriate user of a bathroom shall be estimated with 0 minutes at the equipment of barracks acc .to Standard 1 + 1.		B 07
Normally, no reserves shall be provided for the warm water consumption of washers. Special cases shall be coordinated with the responsible authorities.		B 08
B 11.13.4.2 Calculation formulas		B 09
Peak consumption VSP		
The warm water consumption during main utilization time results as follows under the above listed scope conditions.		
$V_{SP} = Du * P * V_{PB} * \frac{T_{MW}}{T_{Sp}}$		B 10
Formula B 11.11		
Boiler size VTank		B 11
Experience has shown that a boiler volume of 36L per user shall be planned in contrary to the requirements of ETL 1110-3-489.		
The calculated tank size will be then adapted to existing space conditions and available tank sizes.		B 12
$V = P * 36L$		B 13
Formula B 11.12		
		B 14
		B 15

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SOURCE	
Permanent capacity R	B 01
After calculation of required boiler size, the required permanent capacity R can be determined.	
As already explained, the number of user of a bathroom shall be multiplied with time requirement for one shower process for the time of utilization, this means the time during which the warm water is required in the evening.	B 02
This means	B 03
$d \geq 2Pers * 9,5 \frac{Min}{Pers} * 60 \frac{Sec}{Min}$ <p>Formula B 11.13</p>	B 04
A useable boiler content of 60% - 80 % shall be assumed for the determination of permanent capacity. The manufacturer's values shall be taken.	B 05
$M = 60 \% - 80 \%$ $R \geq \frac{V_{SP} * (M * V_{Tank})}{d}$ <p>Formula B 11.14</p>	B 06
Pipe dimensioning	
The dimensioning of pipelines shall be determined acc. to Chapter 33 of the 1997 ASHRAE Fundamentals Handbook.	B 07
A calculation acc. to DIN 1988 Part 3 under consideration of above listed point of views (high simultaneousness) delivers comparable results.	
	B 08
Determination of circulation pump	
The conveyance quantity of circulation pumps is calculated on basis of line length as well as of max. permissible temperature difference ΔT .	B 09
The heat loss usual per meter line length can be determined acc. to table 2 in Chapter 45 of the 1995 ASHRAE Applications Handbook. Usually, the heat loss via pipelines is approx. 0.032 kW/m.	
$q = 0.032 \text{ kW/m}$	B 10
The temperature difference shall be approx. 2 – 5 K.	
$\Delta T = 2 - 5 \text{ K}$	B 11
The conveyance flow of circulation pump with following equation results with values listed above:	
$Q_{ZP} \geq \frac{q}{c_w * \Delta T}$ <p>Formula B 11.15</p>	B 12
	B 13
	B 14
	B 15

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SOURCE	
<p>B 11.13.5 Selection of warm water heater A suitable warm water heater will be selected with above listed calculations acc. to structural conditions.</p> <p>The calculation of capacity of heat exchanger is not described in ETL 1110-3-489 and will be therefore determined acc. to German standards and guidelines.</p>	B 01
	B 02
	B 03
	B 04
	B 05
	B 06
	B 07
	B 08
	B 09
	B 10
	B 11
	B 12
	B 13
	B 14
	B 15

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SOURCE	
<p>B 11.14 Dismantling work</p> <p>In accordance with the local administration it has to be decided if the whole installation will be dismantled.</p> <p>If the whole installation will be dismantled it will be accomplished according to the following instructions.</p> <p>Flush-mounted lines will be dismantled. Deviations from this rule have to be discussed with the local administration before the beginning of planning.</p> <p>The scope of installation to be dismantled shall be determined at the site and included. The costs of dismantling shall be included in the cost estimate.</p> <p>Dismantled system parts and operation agents shall be offered to the local administration for reutilization. As far as requirement exists, turn-over shall be accomplished with proof.</p> <p>If no requirement exists, the material shall be transported and disposed acc. to legal regulations.</p> <p>A confirmation concerning the correct disposal shall be requested from the contractor for the disposal of contaminated system parts (insulation, flange sealing etc.).</p>	B 01
	B 02
	B 03
	B 04
	B 05
	B 06
	B 07
	B 08
	B 09
	B 10
	B 11
	B 12
	B 13
	B 14
	B 15